

Enterprise Data: The Geodatabase Experience

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CADD/GIS Symposium 2000

Overview

- Introduction
- Trends in Enterprise Data
 - Modularization, CDR, www and O-O of COTS
 - Standards
 - SDS, OGC, SQL 99, IAI
 - ArcInfo8, ArcSDE8
- Enterprise CAD/GIS/MIS integration
- Geodatabase experience
- Conclusions

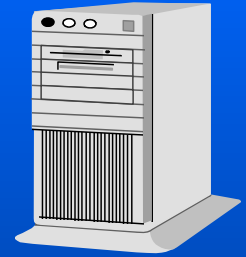
A few simple points

- Object-oriented software technology is taking over fast
- Standards are emerging
- Standards efforts need better coordination
- You can participate
- Start planning for interoperability & O-O best use
- Geodatabase experience very positive, sofar.

Challenges

- How to enable Gov. Eng & FM business processes by providing enterprise access to all data of interest:
 - Spatial (GIS)
 - Design (CAD)
 - Management/Engineering Data (MIS)
- How to best use evolving new technology, trends:
 - Modularization, www and O-O of COTS
 - Strategy and migration path

Historical Perspective of DBMS/GIS



Limited Data Only

Early RDBMS

Dual Database Approach

Spatial Data Middleware

DCOM, CORBA, ERDBMS, SQL99
Unified storage and manipulation
of spatial AND non-spatial data
within common (logical) DB

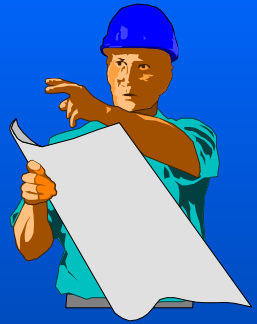
• Stores spatial/non-spatial data into COTS database (proprietary formats).

- Spatial Data in a file & Non-spatial data in database
- Transaction model mismatch between spatial and non-spatial data

- Modular COTS, O-O techn.
- Spatial data types available such as points, lines, polygons within database.
- All Database functionality (e.g. integrity constraints, security, etc)

All apps. will have spatial elements; CAD, GIS for experts

Integrated CAD/GIS/MIS query



- Flood damage estimate

- Estimate the potential flood damage of all facilities that are located within flood path for a given flood crest.

[GIS: Locations, flood depth, terrain
CAD: Building elevation, # floors, {basement, first floor area, links to database records}
MIS: Address and assessment value

Emerging Standards

- SDS
- OGC & Web Mapping Initiative
- SQL99
- IAI -- IFC & aecXML
 - You are invited!
- ArcInfo8 GeoDatabase Objects

SQL'99

- ISO Standard - out to ballot late 99
 - UTDs - user defined types, attributes, methods, inheritance, polymorphisms
- SQL/MM, part 3 -- “Spatial”
 - UTDs - point, line, curves, polygon
- Attempts to harmonize with OGC
- Status

International Alliance for Interoperability

- Mission
 - Facility lifecycle, information exchange
- Status
- IFC -- Industry Foundation Classes
- aecXML -- web-based data transport

The IAI Mission

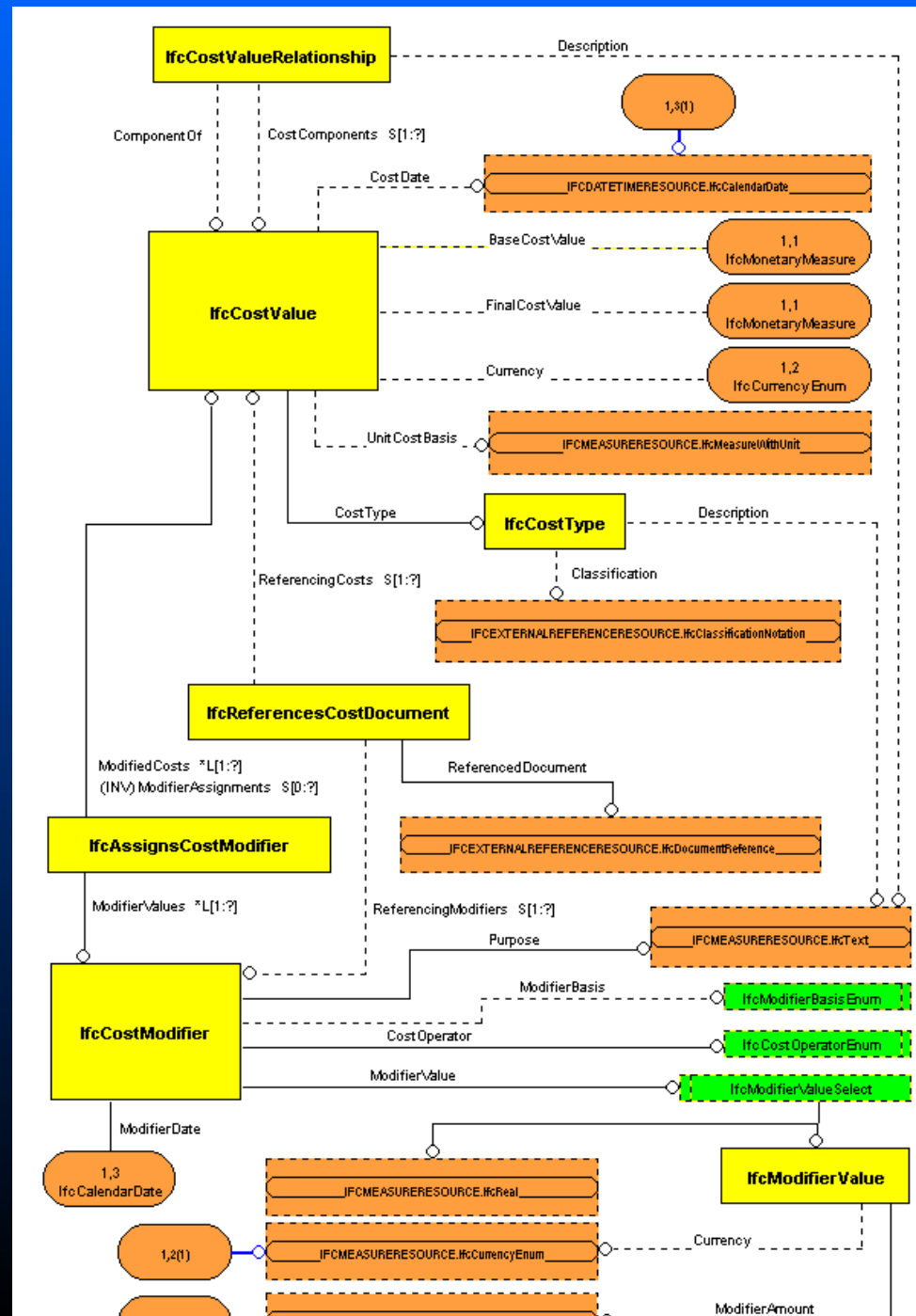
- Enable interoperability among industry processes of all AEC/FM professions.
- By enabling all participants' computer applications to share and exchange project information.
- *Scope*: entire life cycle from strategic planning, design and engineering, construction, to building operation (GIS not addressed yet)
- *Goal*: develop a specification for sharing data throughout the project life cycle, globally, across disciplines and technical applications.
- ***The Industry Foundation Classes (IFCs)***
- ***aecXML***

IAI Status

- About 600 member companies/organizations worldwide
- 9 Chapters:
 - North America, German-speaking countries, United Kingdom, France, Singapore, Nordic countries, Japan, Korea and Australasian
- 7 NA Domain Groups
- IFC Release 2.0 published, R2.x open for review
- 15 commercial software demonstrations in Feb. (At 3:30 today demonstrate 6 software products in: AEC + FM object technology workshop.)

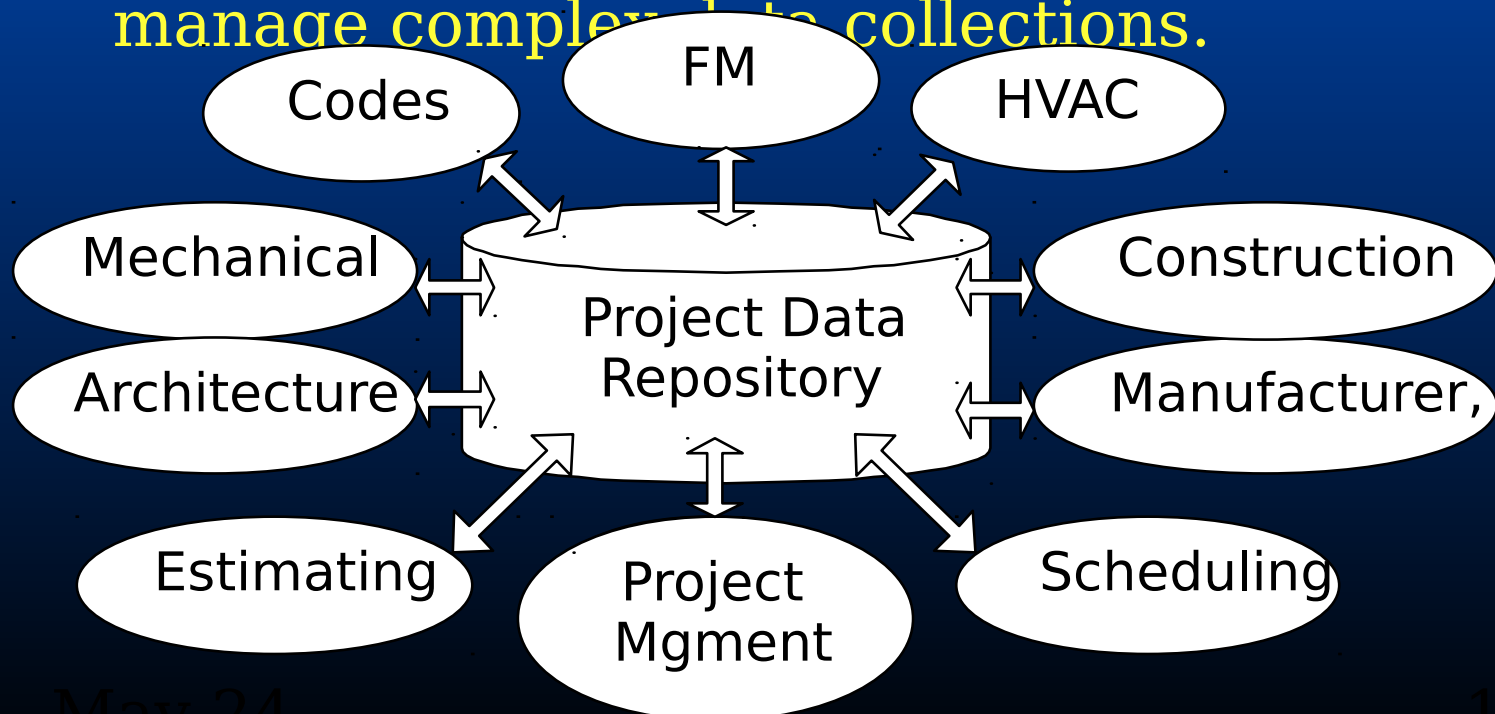
Elements of the IFCs

Opportunity for CAD/GIS integration at the object level



Implementation Scenarios

- Applications exchange project data through a common project data repository.
 - Centralized or distributed.
 - All applications contribute to and draw from database.
 - More difficult to construct, but easier to manage complex data collections.



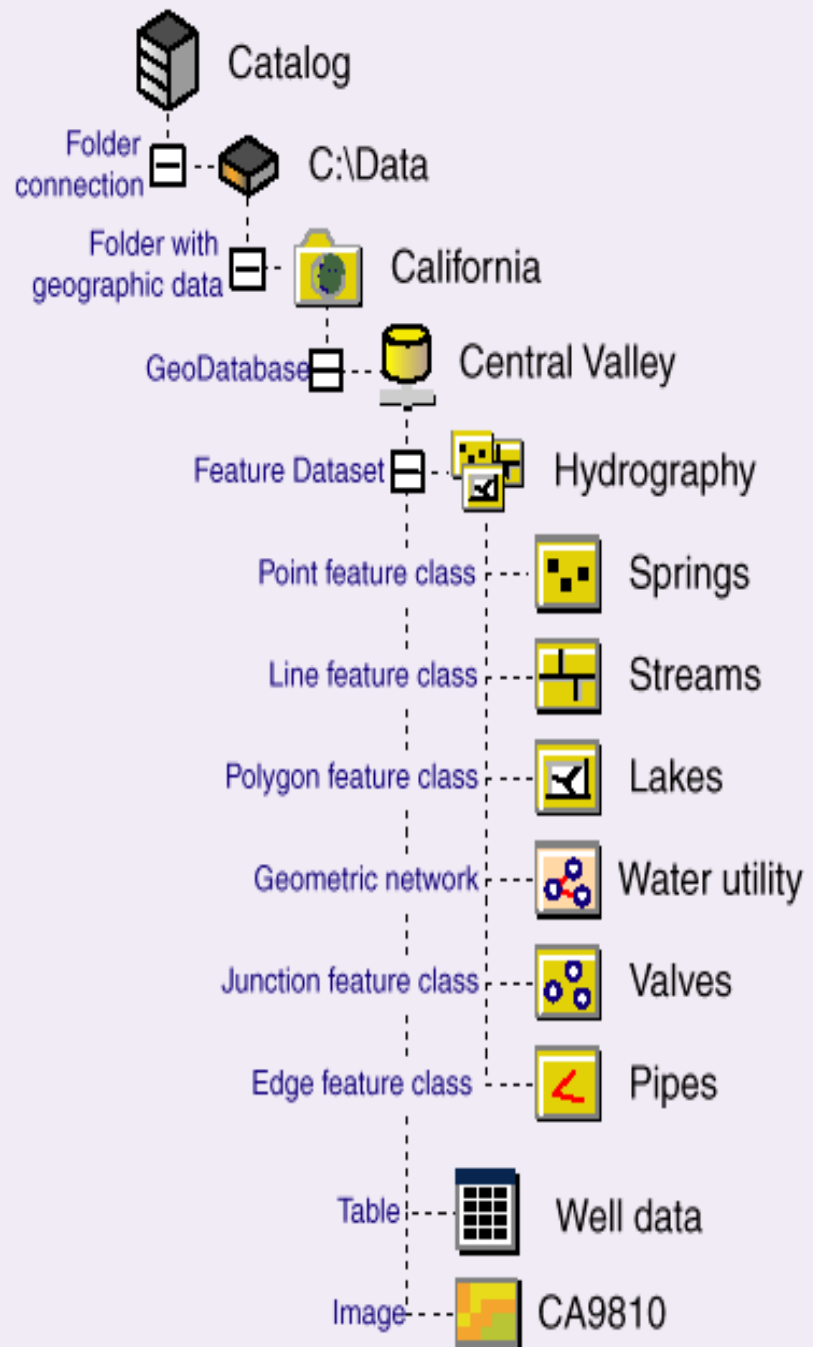
ArcInfo8

- Introduction
- Modules
 - ArcMap
 - Geodatabase objects
 - Automatic Reprojection
 - ArcCatalog
 - Contents (Geodatabase feature classes, Coverages, Shape files, raster, TIN)
 - Preview
 - Metadata
 - ArcTools
- ArcSDE8

ArcSDE8

- Application to manage, convert and store mixed data in COTS Relational DBMS, in a way that provides seamless data access to GIS and other client applications. It enables object-oriented mixed data, as well as “traditional” formats.
- Personal SDE
- Enterprise SDE
 - Works with 3-4 COTS Relational DBMS
- Geodatabase
 - Data collection including O-O feature classes created and managed by SDE in a RDBMS.

ArcInfo8 Object Architecture



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Sample Object in ArcINF08

Object attributes

Blob stores complex data objects such as geographic features and images.

Date is a field that is formatted to hold year, month, and day.

Double is a real value number with double precision (8-bytes)

Geometry is a special field that contains the shape of a feature. Geometries are 0, 1, or 2 dimensional.

Integer contains a whole number, positive or negative.

Object identifier is a unique key value for the lifetime of an object.

Single is a real-valued number with single precision (4-bytes)

Small integer is whole valued number between -32767 and 32767.

String is a set of characters for properties like names.

Object Stream
Blob
Date
Double
Geometry
Integer
Object identifier
Single
Small integer
String
DefineFromPoints ()
PutCoords ()
AddStream ()
DeleteStream ()

Object functions

DefineFromPoints () defines points to create a stream.

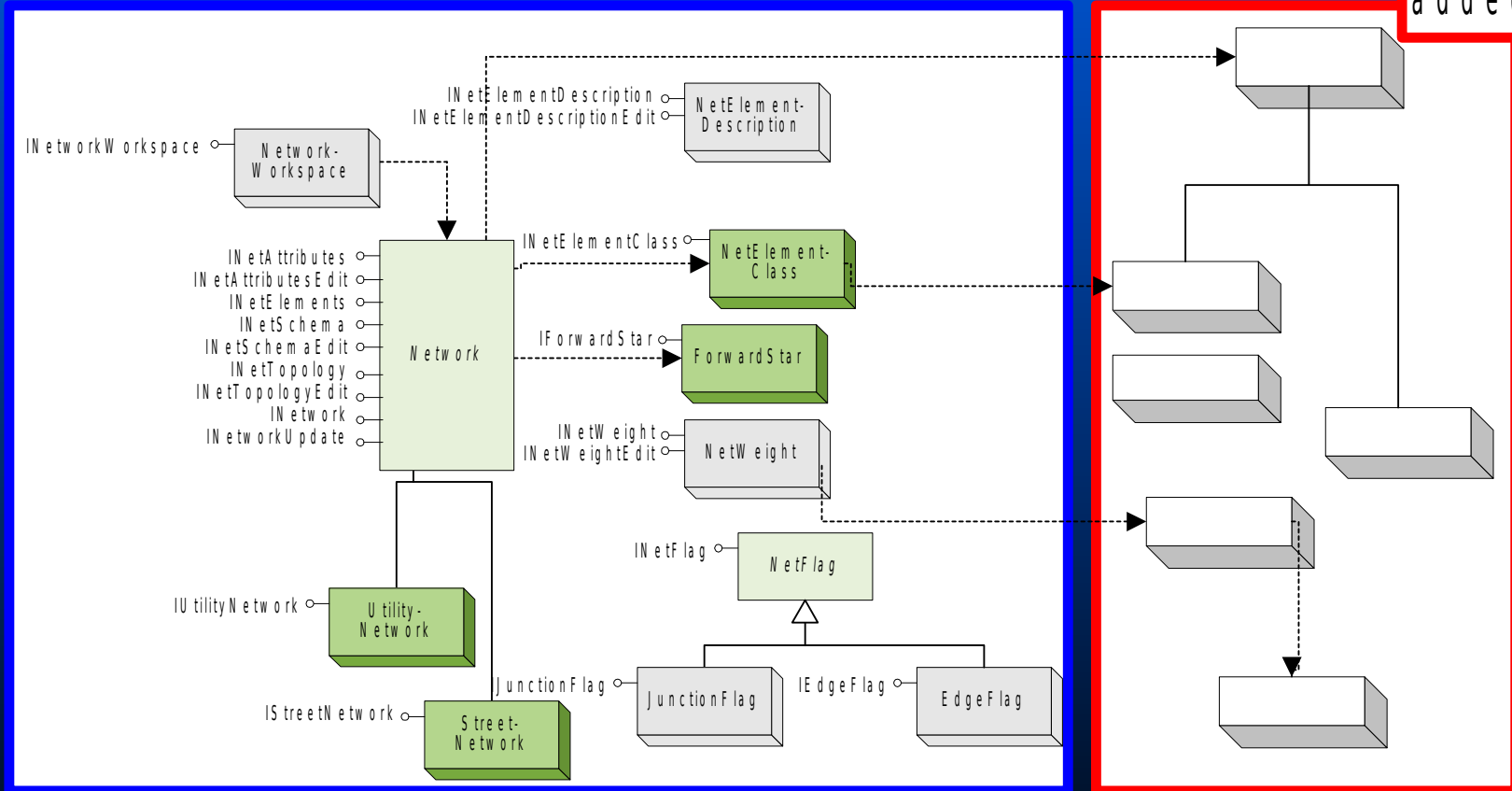
PutCoords () is used to store x,y coordinates to create a stream.

AddStream () is used to create a new stream with the same type of stream created already.


DeleteStream is used to delete a stream from the application.

Develop objects in ArcINFO 8

Object specializations added by User



Objects Provided
by ArcINFO

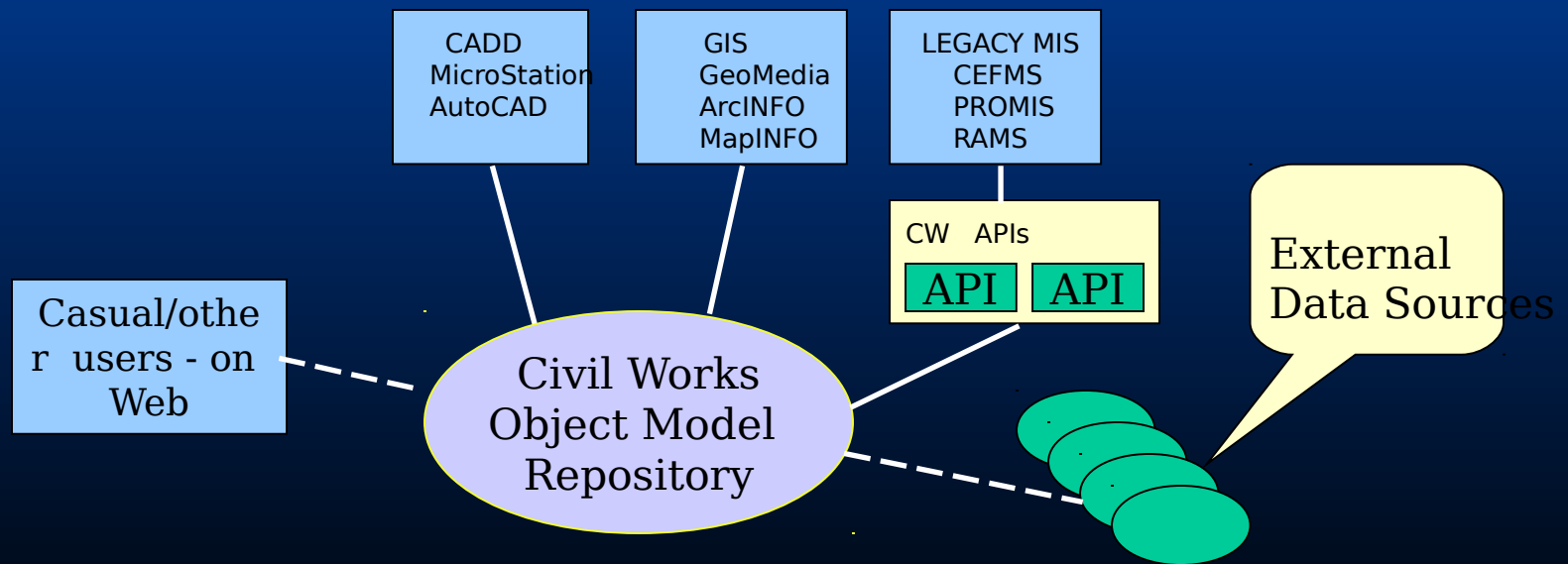
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- Section 1-- Recap :
 - Object-oriented software technology is taking over fast
 - Standards are emerging
 - Standards efforts need better coordination
 - You can participate
 - Section II -- What can be done to our best benefit



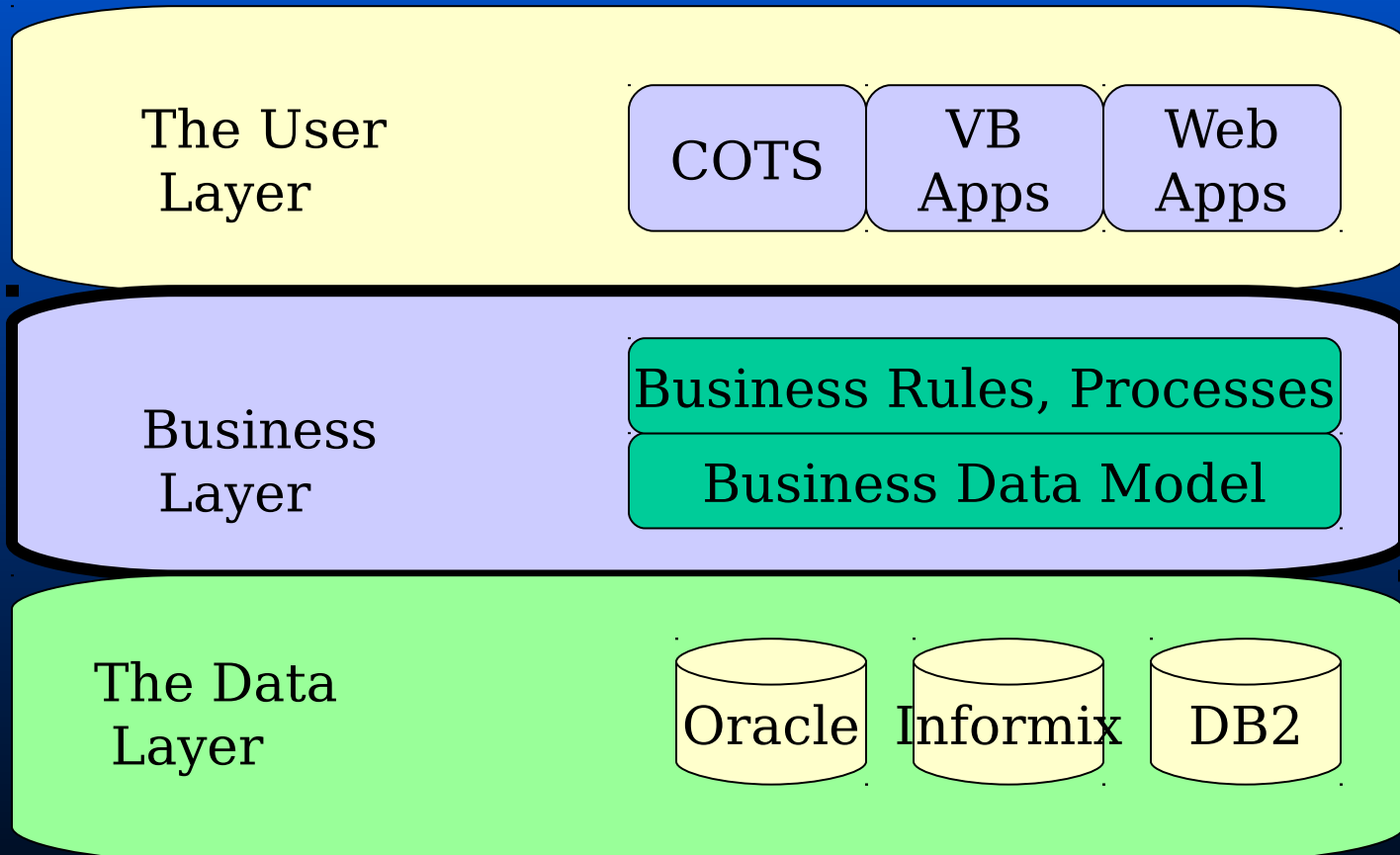
- Strategy for Civil works to benefit from O-O COTS, integration, modularization of software.
 - Common data repository prototype
- Provide integration capability for GIS/CAD/MIS data for Civil Works, provide easy access.
 - Provide CAD/GIS/MIS interoperability tools
 - Rapid, easy spatial searches & data linking
 - Web/Client/Server architecture (Sharing data)
- LMS Contribution

Long Term Goal - Conceptual

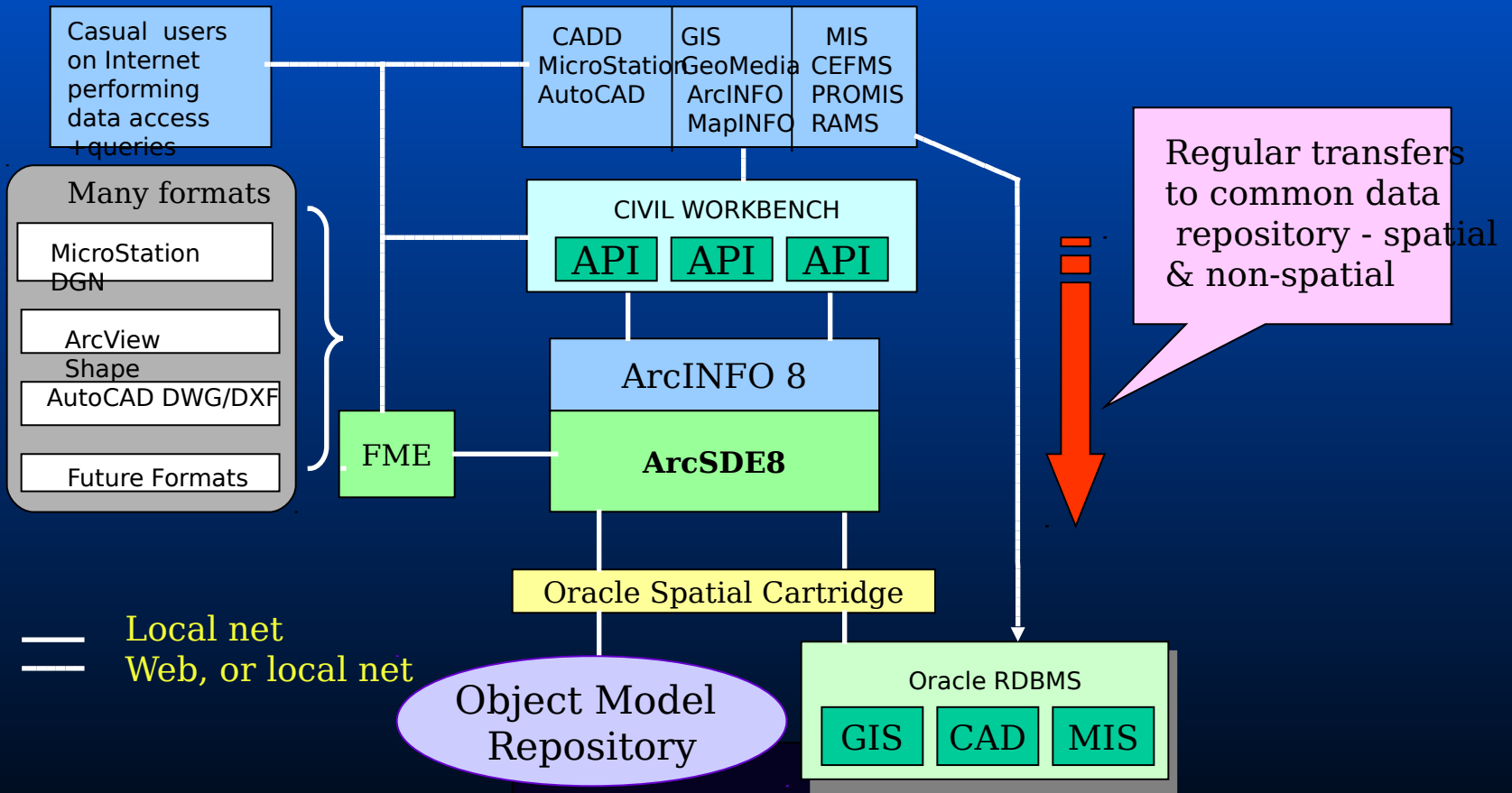
- Object Model Repository (OMR) - owned and controlled
- COTS are interchangeable
- COTS operate on OMR using industry standards
- APIs provide links with Legacy systems




A 3-Layer Approach



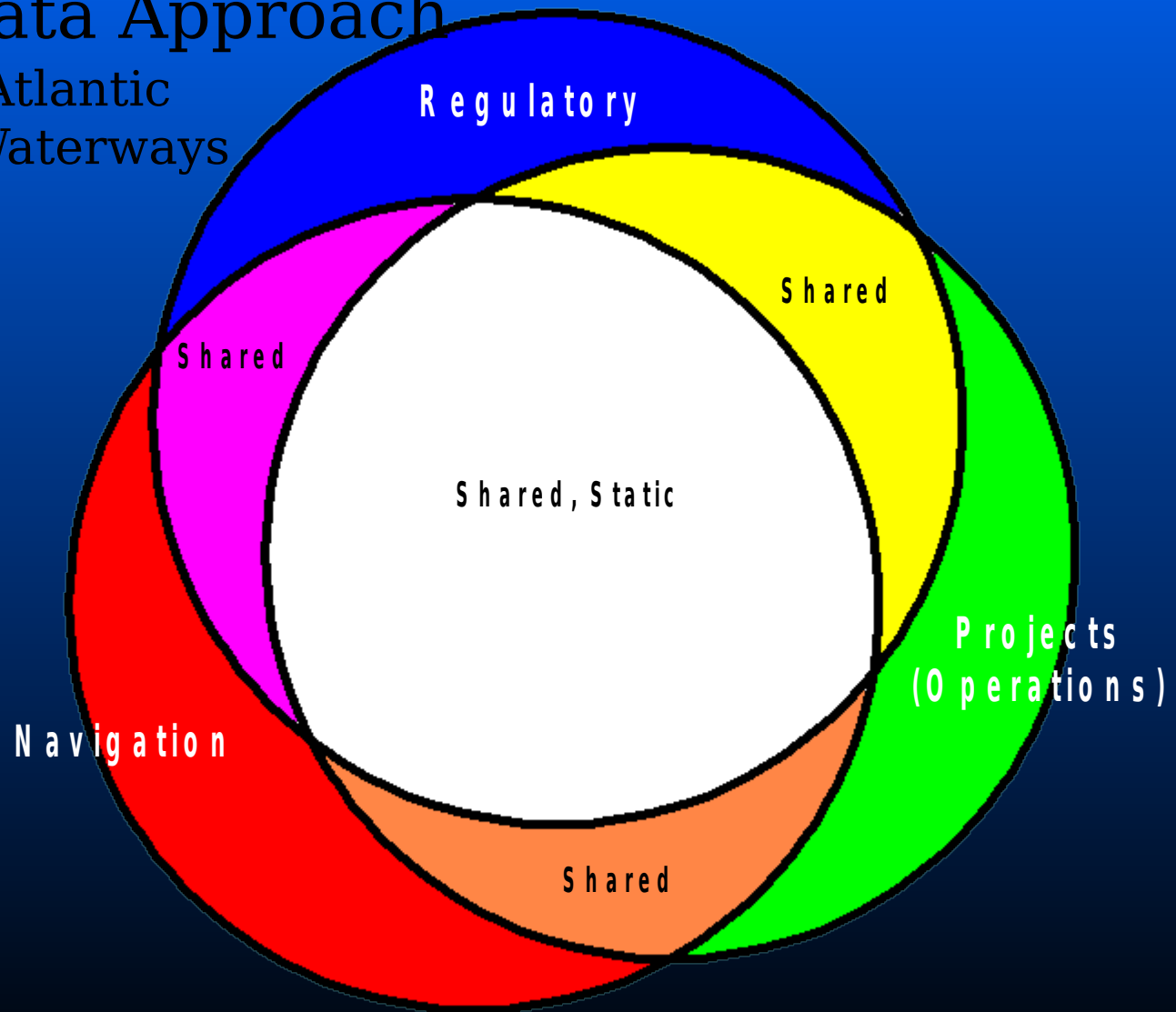
Civil WorkBench Architecture



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- Section 1-- Recap
 - Section II -- What can be done to our best benefit
 - Common data repository approach
 - Section III -- CDR demonstration:
Geodatabase
Experience

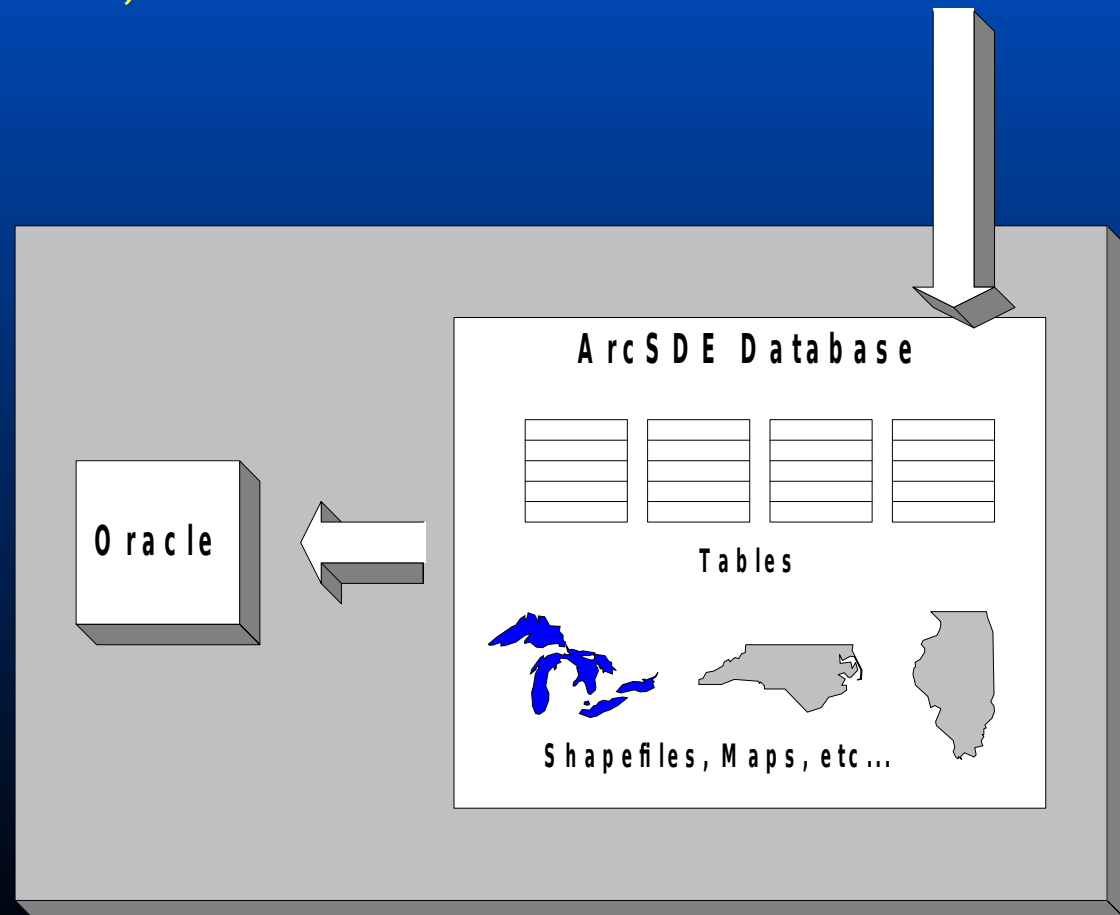
Wilmington District Common Data Approach

300+ miles of Atlantic
Intra-Coastal Waterways



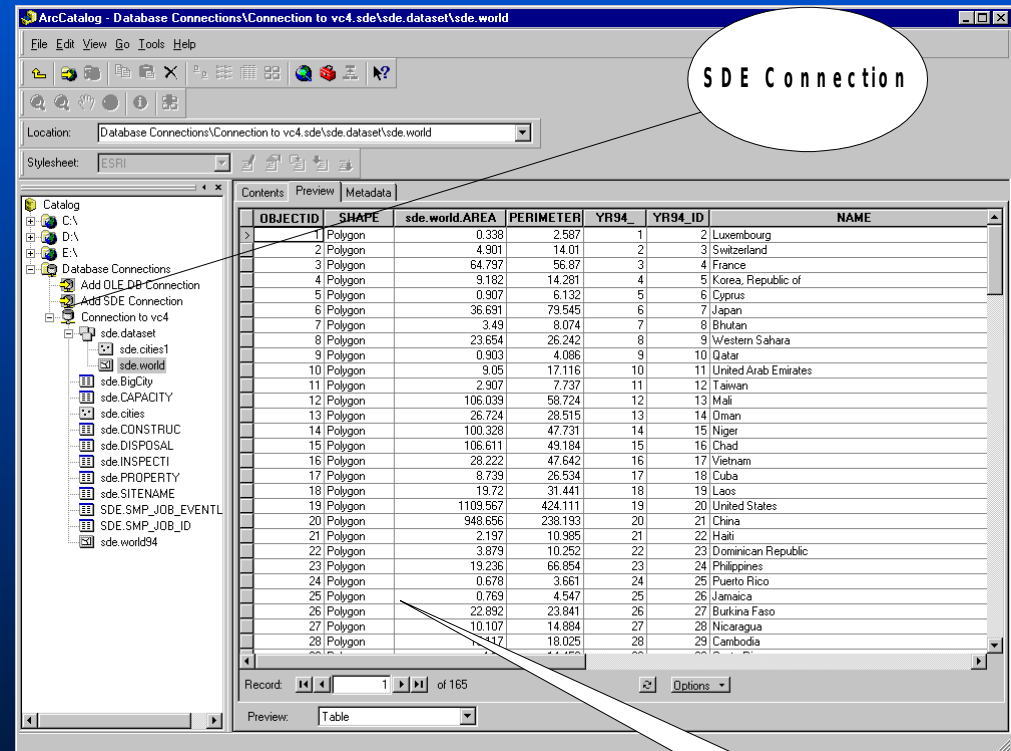
Geodatabase Scheme

The application being developed will connect to an ArcSDE database which exists inside an Oracle relational database. The SDE database contains shapefiles, coverages, tables, etc.



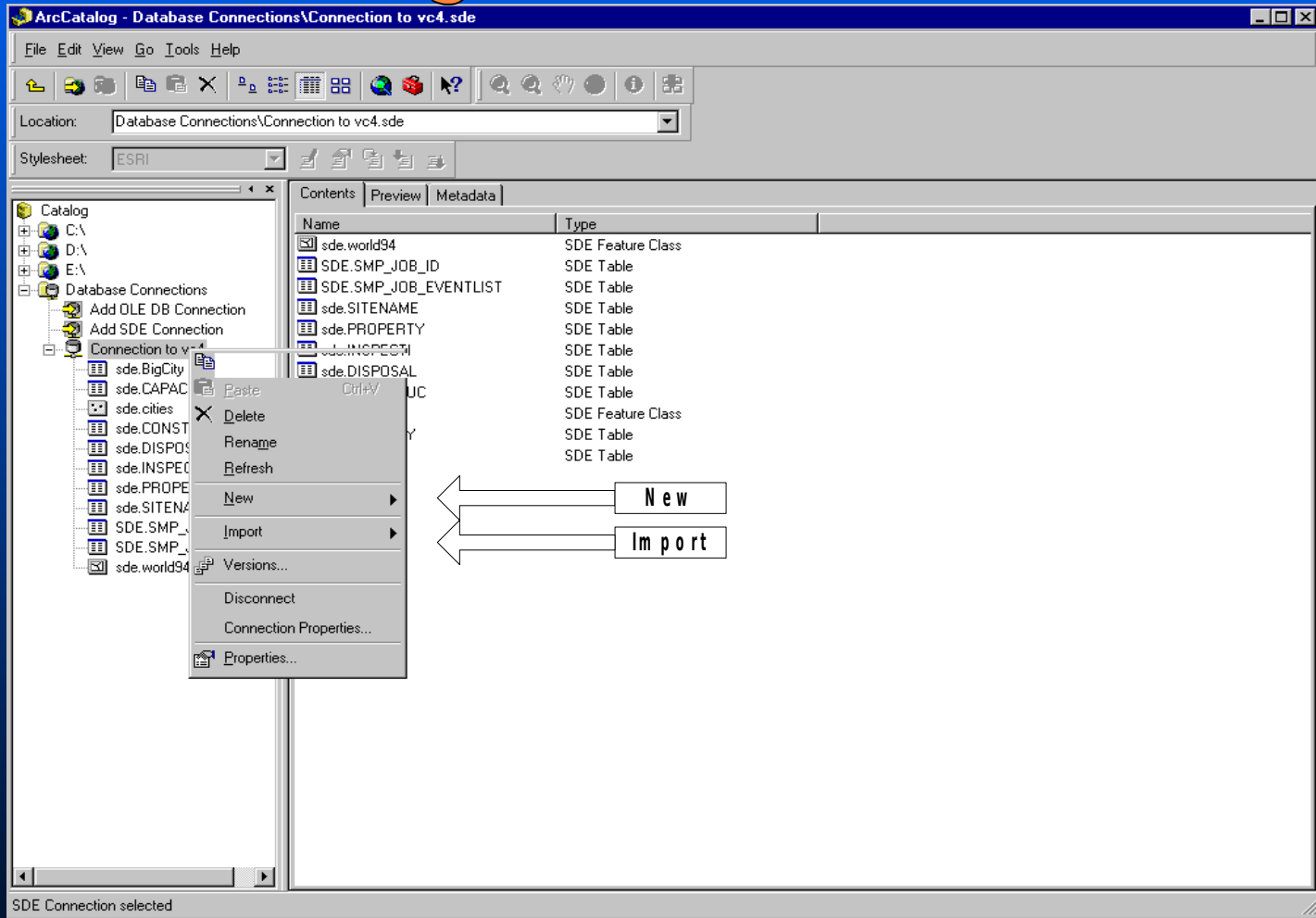
Connecting to the Database

- ArcCatalog connection
- Username, password...
- Feature classes store both geometry and attribute data
- Database tables store non-spatial attribute information. Similar to SDS entity types. Often used for relationships



Geometric and
Attribute Data
in Tabular Form

Filling the Database



Spatial files, tables, etc can be imported or created using ArcCatalog and stored in the SDE database

location : Table				
	da number	state plane x centroid	state plane y centroid	latitude c
▶	404	10	10	100
	405	20	20	200
*				

Location

property_owner : Table						
	da number	Last Name	First Name	Address	City	State
	404	Smith	John	CERL	Champaign	IL
	405	Doe	John	CERL	Champaign	IL
*						

Property Owner

capacity : Table					
	id	da number	capacity	date	remarks
	1	404	500	1/1/2000	Remark1
	2	405	1000	1/2/2000	Remark2
▶					

Capacity

inspection : Table					
	da number	inspection date	inspector name	method	remarks
	404	2/9/2000	John Smith	visual	remark1
	405	2/10/2000	John Doe	visual	remark2
*					

Inspection

construction_event : Table					
	da number	date of completion	contractor	cost of construction	remarks
	404	2/10/2000	John Smith	3000	remark1
	405	2/11/2000	John Doe	4000	remark2
▶					

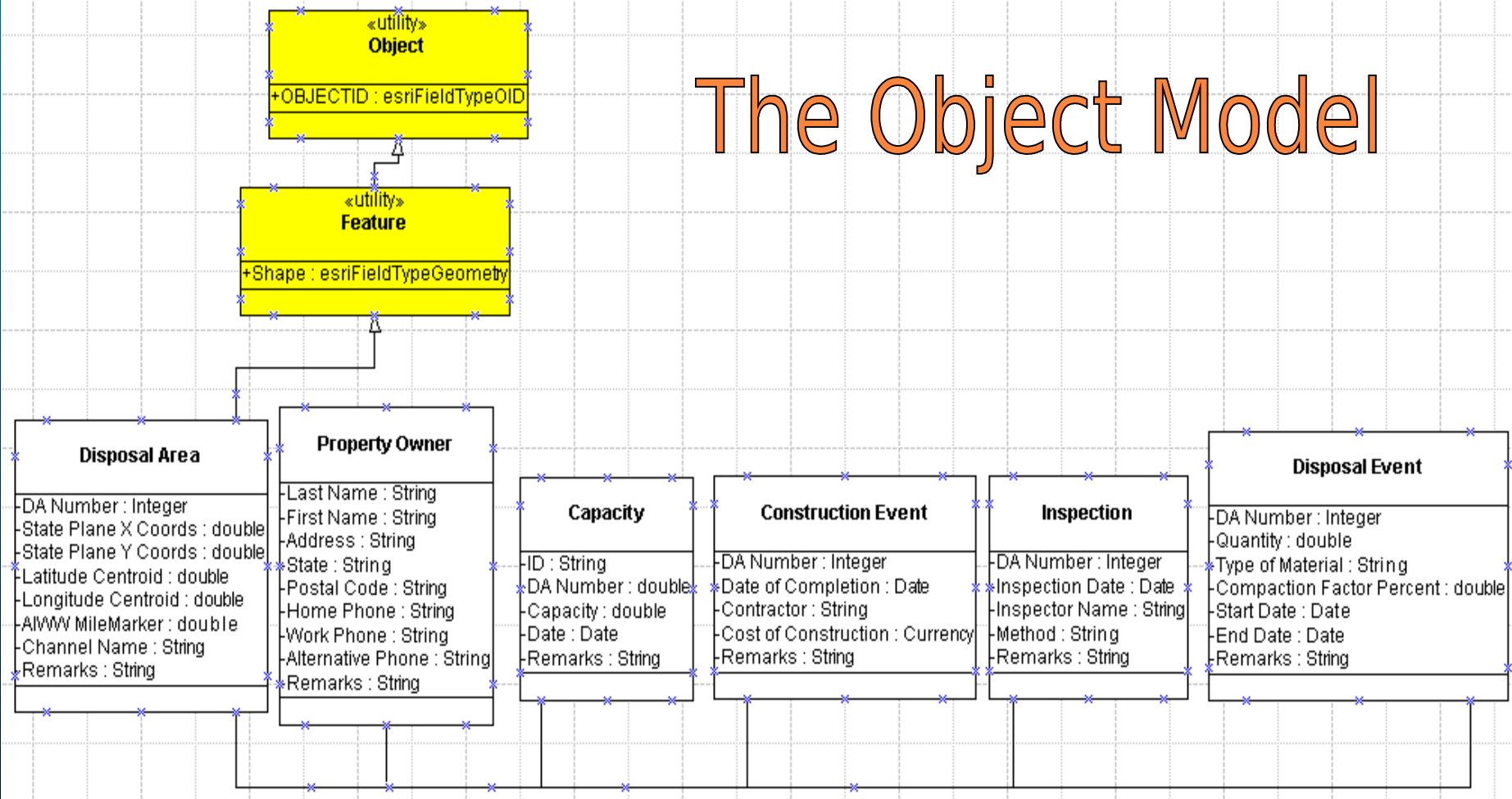
Construction

disposal_event : Table					
	da number	quantity	type of material	compaction factor	start date
	404	40	dirt	4	11/30/1999
	405	60	sand	5	11/30/1999
▶					

Disposal

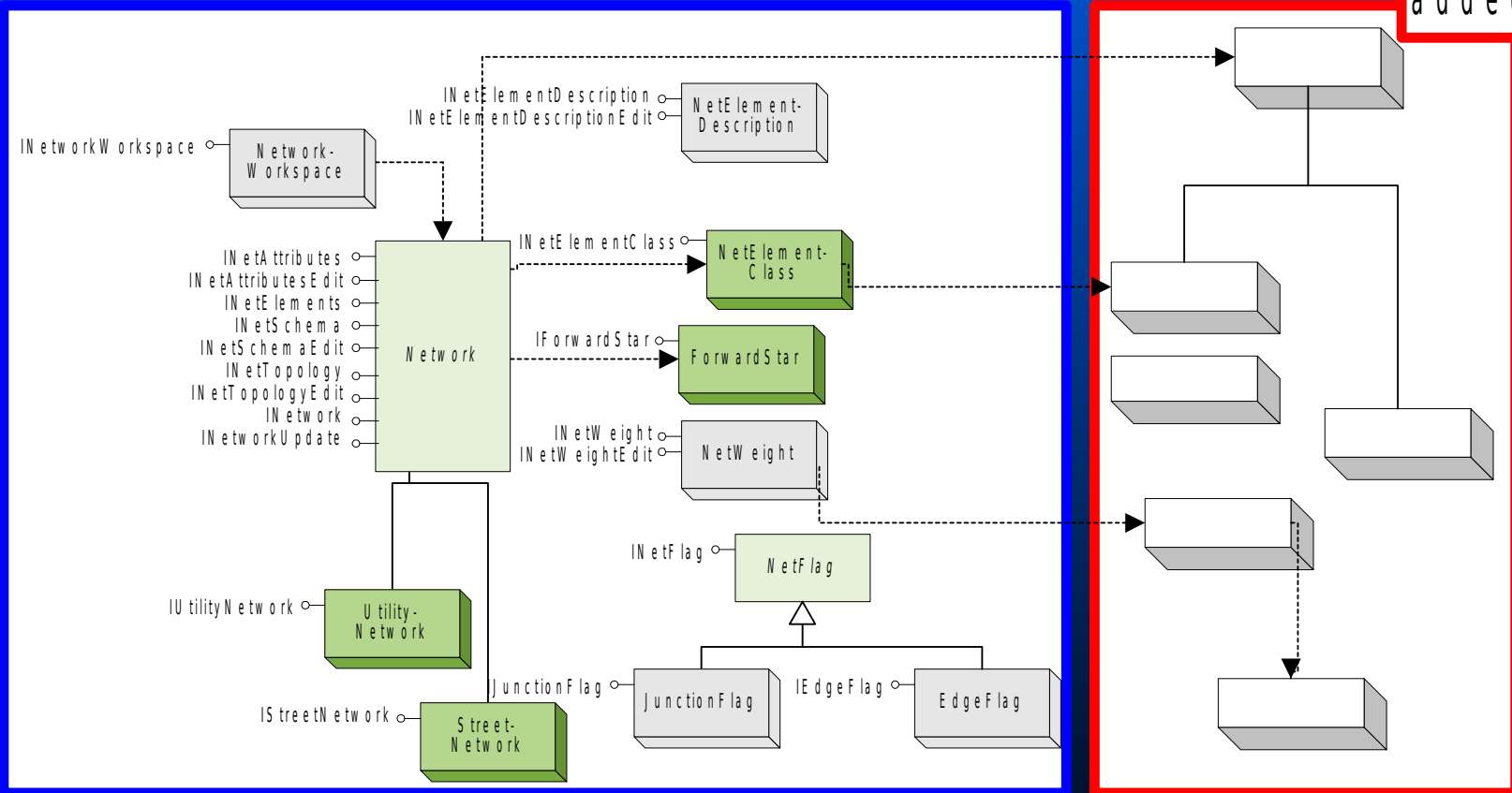
Tabular values of attributes for the application.

The Object Model



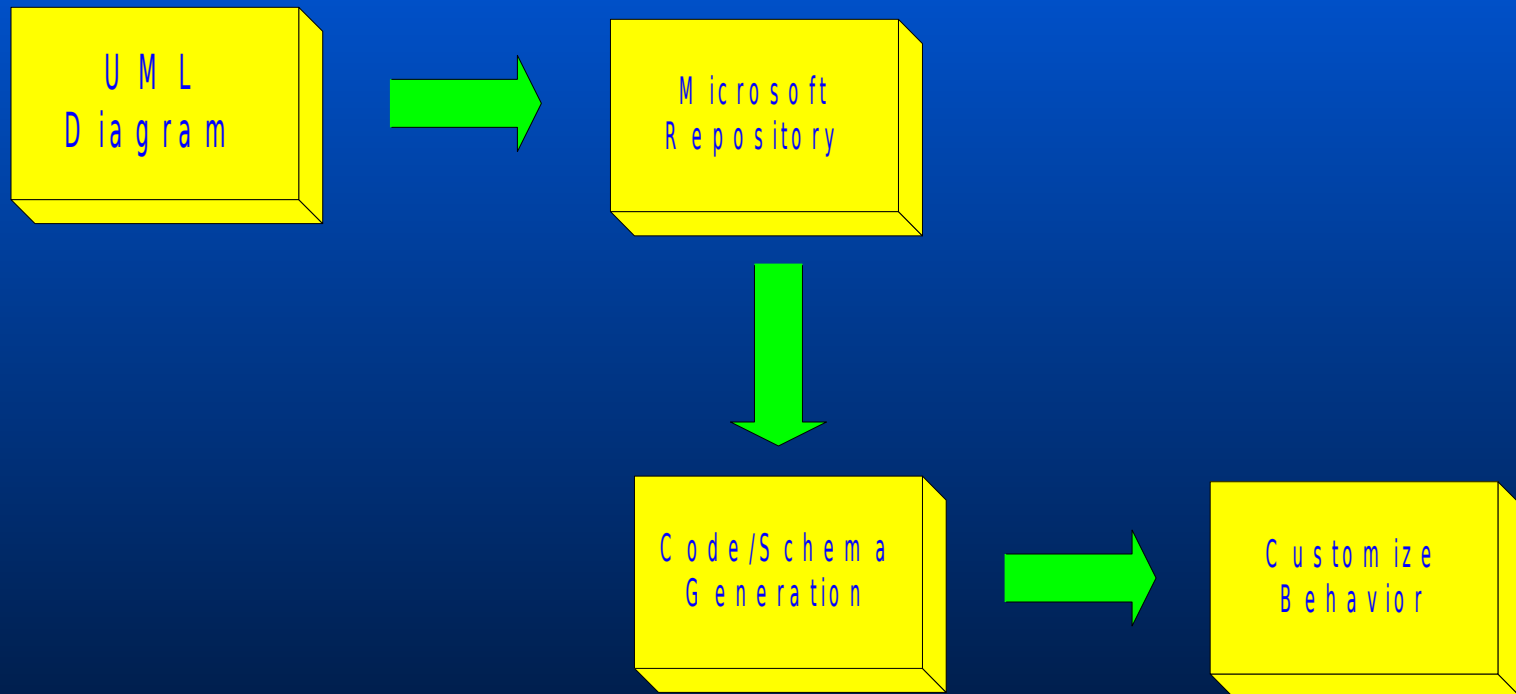
Develop objects in ArcINFO 8

Object specializations added by User



Objects Provided
by ArcINFO

Creation of Custom Features



This schema generation allows you to create feature classes that contain attributes of user specification which leads to custom behavior

Current Status

- Rapid prototyping
- ArcSDE database creation and connection
- UML diagram created with defined custom attributes
- Exported to Microsoft Repository
- Schema/Code generated
- Working on compilation errors

Plans


- Regenerate skeleton code/schema using updated compiler and/or refined UML diagram
- Proceed to write code for custom behavior
- Import custom feature class into ArcCatalog
- Complete user interface (VB application)
- Test by FY end

Advantages of Object Orientation

- Provides chance to minimize unnecessary or uncaught errors.
- Allows interaction between objects
- Adapts to new objects entering or leaving a map
- Behavior, especially shared



- Rapid pace of development
- Technology (almost) ready to support true internal and external integration
- Everything is going O-O
- Real challenges
 - Define objects and object models
 - Reengineer processes to benefit from integrated data availability
 - Migration to O-O

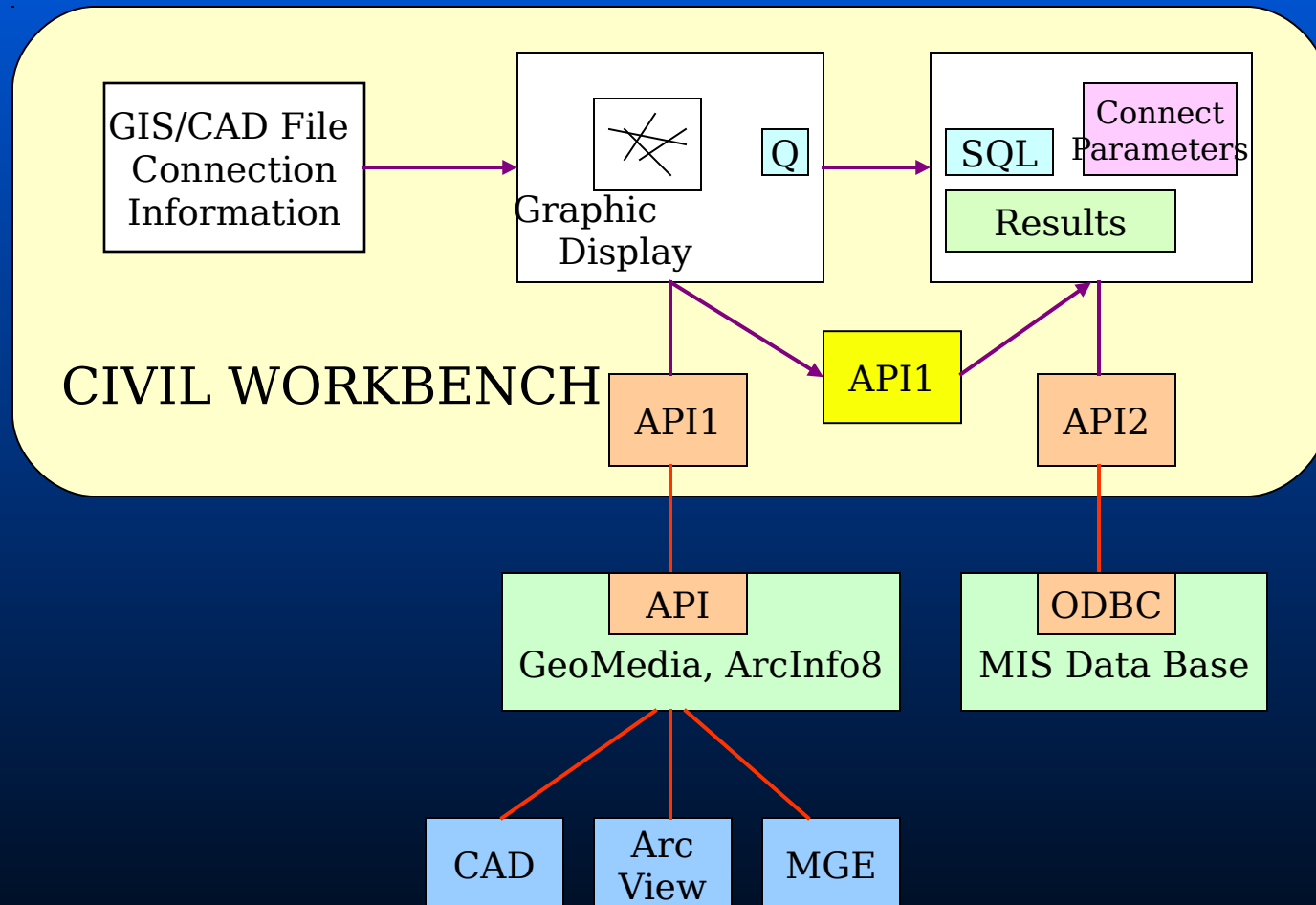
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- ESRI Geodatabase provides semi-proprietary solution
 - Integrate CAD, GIS, MIS in enterprise database
 - Develop O-O elements
 - SDS provides rich starting point, but much work is still needed
 - Review of business processes -- identify benefits
 - Strategy for migration
 - Begin to ask for interoperability
 - Industry efforts need support/direction
 - Participate



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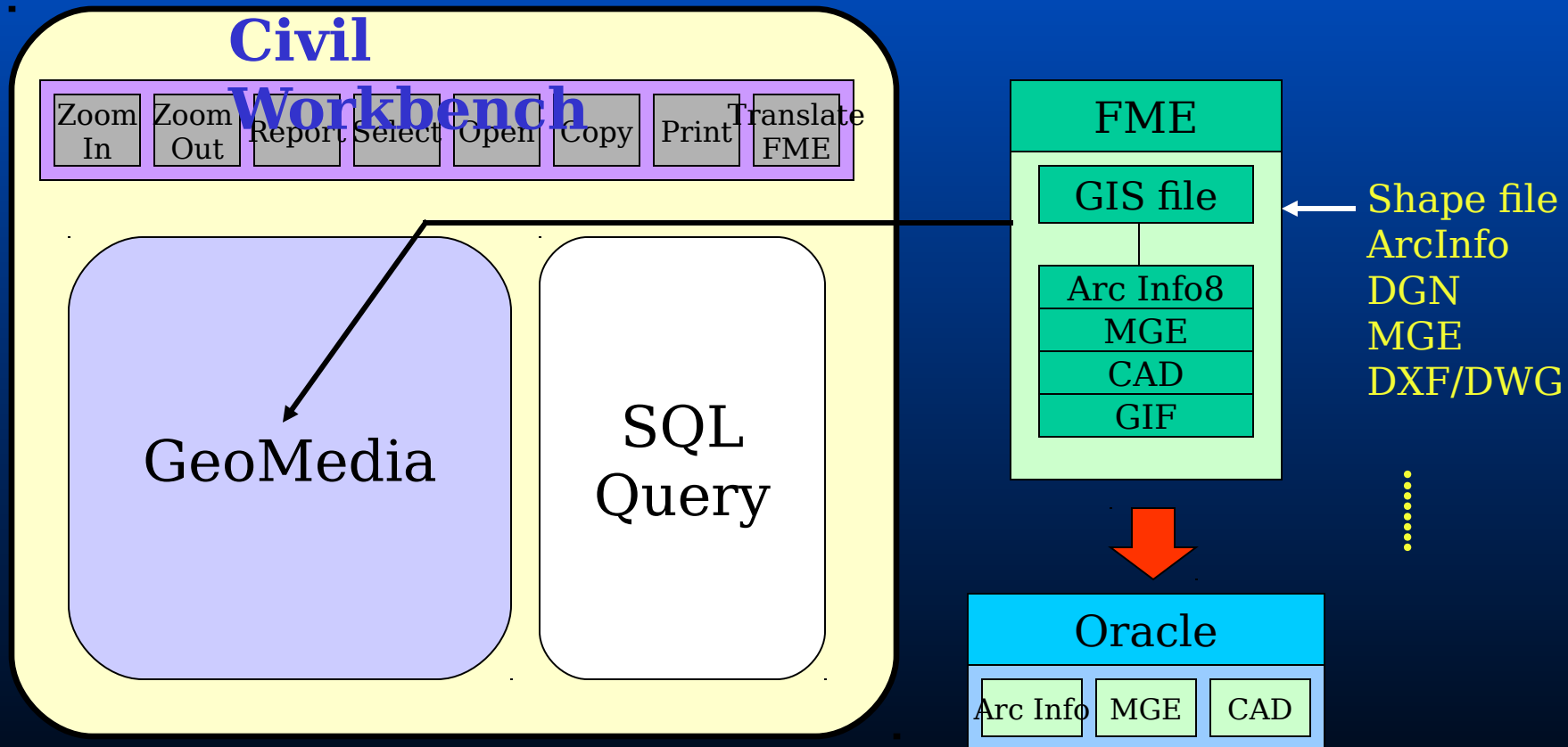
38

Civil Workbench: Current Status



Civil Workbench

Integration of FME



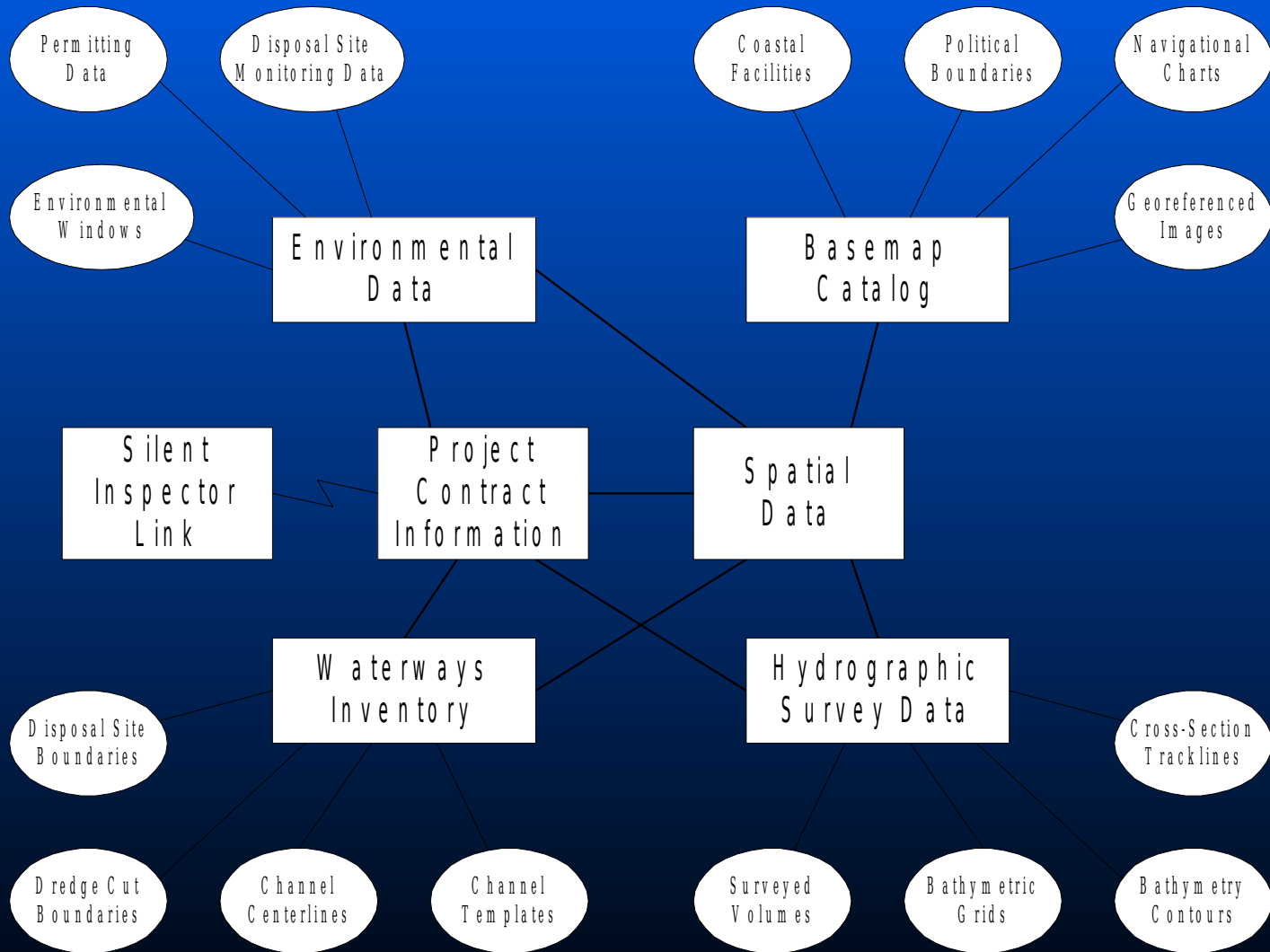
FME

Feature Manipulation Engine

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DMSMART: Database overview



Inactive Disposal Areas (ARC/Info Centroid Point)

 DA_CODE



Active Disposal Areas (ARC/Info Polygon Coverage)

 DA_CODE



Beach Disposal Areas (ARC/Info Line Coverage)

 DA_CODE



Disposal Event

 DISEV_ID (Disposal Event ID)
 DA_CODE (DA for disposal)
 CY (Cubic Placed in DA)
 DATE (Date Material Placed)
 ORGIN (Material's Origin RTC or DA Code)
 DRG_NAME (Dredge Name)

Survey Event

 SRVEV_ID (Survey Event ID)
 DA_CODE (DA for disposal)
 SUR_NAME (Surveyor Name - or -
 "Estimate" if not surveyed)
 DATE (Date of Survey)
 SUR_CAP (Surveyed Capacity)
 DASUR_FILE (File Name of Survey Data)
 DTM_FILE (Digital Terrain Model file name)

DA_Information

 DA_CODE (DA_Code #)
 NEW_DA_Number (# From Table 3)
 OLD_DA_Number (# From Table 3)
 County (County Name)
 Mile_marker (Nearest Mile Marker)
 Landmark (Nearest Town, etc.)
 RTC_CODE (RTC_Code Nearest Channel)

ENV_COMP (FUTURE TABLE)

 DA_CODE
 Env. Compliance Database

CWB_DATA (FUTURE TABLE)

 DA_CODE
 Colonial Water Bird Database


Environmental_Assessment

 DA_CODE
 Environmental Assessment

ENV_COMP (FUTURE TABLE)

 DA_CODE
 Env. Compliance Database

ENC_PERMIT (FUTURE TABLE)

 DA_CODE
 Encroachments
 Permit Violations

Revised 12 May 2000

**AIWW
DA Databases**

Many to one relationship
 (Does not include future Databases)

May 24,

43

SDS: Disposal Area

Entity Type

disposal area

Table

ls mgtdsp

Attributes

datalink
drgmat_id
map_id
meta_id
media_id
coord_id
grid_value
feat_name
sur_crs_id
up_riv_mil
dn_riv_mil
date_start
date_end
volume_u_d
volume
area_size
area_u_d
perim
perim_u_d
instln_id
facil_id
user_flag

Web Mapping Initiative

- See <http://www.opengis.org/wmt/>
- Goals - ad hoc GIS data via Internet
 - Picture Case - GIF, JPEG, browser
 - Graphic Element Case - ActiveX
 - Data Case - XML definitions
- Status
- Challenges

Web Mapping Initiative

- Status - Sept 10, Demo I
- ~20 servers (U.S., Europe and Australia) were included in the demo. Each participant got the following protocols:
 - Get Map - communications ability
 - Get Capabilities - what the server can do
 - Get feature Info - query
- Late 2000 -- Demo II